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REGENERATION
Planting
(Pelleted Seed)

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PELLETED SEED FOR REFORESTATION

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Reforestation by means of pelleted seed sown directly in the field has attracted much interest recently. In 1947 the Station participated in a small test which showed no advantage for pelleting. However, several new pellet materials and techniques have been developed recently, so that further exploratory tests are desirable.

As a basis for planning new tests of pelleted seed, all agencies known to have conducted such work have been contacted. The information obtained from them is summarized here.

PURPOSES OF PELLETING

Pelleting seed is not a new idea. It has been tried intermittently on a small scale at least since the time of the First World War. However, large scale use and commercial pelleting did not arise until the Second World War. It was tried then by the sugarbeet industry in connection with the development of drill seeders capable of very accurate sowing.

There are two main purposes of pelleting seed: One is to provide more economical use of seed through better control of distribution in sowing, and the other is to provide favorable conditions for seed germination on the soil surface. For reforestation the greatest advantage probably would be the possibility of establishing seed spots without the development of multiple seedlings. If at the same time pellets could be developed which provided protection of the seed and seedling from damage by rodents, birds, disease organisms and other enemies while fostering good germination, this would be so much added advantage.

METHODS OF PELLETING

A variety of materials has been tried for making pellets. Ideally a pellet material should be easy to handle in rapid processing, should not be injurious to the seed either before or after germination, should be sufficiently firm to permit reasonable handling in seeding apparatus (and in some cases airplane seeding), yet should disintegrate under favorable moisture conditions rapidly enough to avoid hindrance to seed germination, and it should be reasonable in price. Aside from these characteristics, a pelleting material should also permit the addition of nutrients, repellents, insecticides, fungicides, or hormones.

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[1] Maintained by the U. S. Department of Agriculture, Forest Service, in cooperation with the University of Minnesota, University Farm, St. Paul, Minnesota.

The most common pelleting materials are clays of various kinds. Aside from local clays, these include modelling clay, ball clay, kaolin, and montmorillonite (a soft clay-like mineral of hydrous aluminum silicate). In addition, the following materials also have been used alone or in various mixtures with or without clays; ground rattle bush bean, plaster of Paris, tung nut pomace, dextrin, powdered foamglass, dithiobiuret, anthraquinone, feldspar, fly ash, and diatomaceous earth. To these materials there have usually been added various rodent repellents and frequently also fertilizers, fungicides, insecticides, or growth hormones.

Pelleting Processes

Many pellets for small scale tests have been made by hand. However, this is too expensive for large scale work, so several commercial processes have been developed. These are of two general types; accretion processes in which the pellets are built up by adding successive layers of material, and pressure processes in which the seeds and pelleting material are forced through openings. Three companies are now known to produce commercial pelleted seed. They are: The Filtrol Corporation of Los Angeles, California; the International Seed Pelleting Company of Phoenix, Arizona; and Processed Seeds, Inc., of Midland, Michigan.

Apparently the first in the field was Processed Seeds, Inc., which has operated under different names (Chemi-Coat Seed Company, American Seed Processing Company) since its inception during World War II. The seeds are coated in a machine which superficially resembles a cement mixer. As the spherical shaped pan rotates at about 45° from the vertical the seeds are tumbled over one another. The seeds are moistened with an adhesive (methyl cellulose) and then powdered material is added (feldspar and fly ash) which adheres to the adhesive covered seed. After the coat has dried, successive coats are added until the pellet is the desired size. Fertilizers, repellents, and other materials can be added and pH can be controlled as desired. Pellets of Douglas-fir and presumably most other conifers are elliptical in shape. Recent quotations for pelleting in large batches (seed furnished by customer) range from $.14 per pound for seeds like white pine to $.20 for those like spruces and firs.

The International Seed Pellet Company uses a process developed by Dr. L. S. Adams, its founder. Seeds are mixed with adobe clay which is placed in a machine consisting of four gear-like wheels which mesh in such a manner that a moist seed-filled clay mix is pressed from four sides into spherical balls at rates reported up to 48,000 per hour. These pellets were designed especially for aerial seeding of grasses.

The Filtrol Corporation develops their "Filcoat" pellet from a highly colloidal aluminum silicate (montmorillonite). Seeds are placed in a drum and moistened by a spray of water. Then the coating material is added and the seeds are tumbled about. The addition of moisture and coating material is continued until the pellets are of proper size (Douglas-fir pellets are 1/4 inch in longest diameter). The pellets are screened to get uniform size and then are dried by forcing a large volume of air across them. If the humidity is high, the air is heated to about 10 degrees F. above atmospheric temperature. Repellents, fertilizers, and such materials can be added and pH controlled as desired. The cost of pelleting Douglas-fir seed has just about equaled the cost of the seed.

Related Processes

Several other methods of coating seeds were tried at the Pacific Northwest Forest and Range Experiment Station. These were pressure-formed tablets (calcium carbonate), gelatin capsules, hand-rolled pills (powdered sugar), machine-rolled pills (powdered sugar), and triturate tablets (powdered sugar). For one reason or another all proved unsatisfactory. The Crown Zellerbach Company is trying capsules containing Flowerite and vermiculite with seeds, fertilizers, growth hormones, and fungicides.

A graduate student (Joe Clark) at the University of Washington has developed a tablet which, along with 2 seeds, includes leaf mold, Douglas-fir bark, peat moss, and redwood bark reduced to definite sizes. Apparently somewhat similar were the briquets developed by Dr. S. A. Wilde at the University of Wisconsin several years ago. These were compressed peat, seed, and nutrients.

Good and Bad Features of Various Pellets

For either aerial or ground seeding the added weight of pellets carries the seed through brush, leaves, and grass and gives it a better opportunity to reach the soil and take root. Pelleting permits better control of smaller seeds. A general disadvantage is the added bulk and weight of pelleted seed. This varies considerably. Jack pine seed in pellets of one type weighed 9 times the amount of bare seed. Douglas-fir seed increased in weight about 20 times when pelleted by another process; and certain grass seeds pelleted by a third process weighed 920 times as much as when bare.

Certain kinds of pellets have disadvantages for certain purposes. The Processed Seeds Company type has not been hard enough for use in the walking-stick planter developed in the Pacific Northwest. The International Seed Pelleting Company type may be sufficiently irregular in shape to cause excessive wear on some aerial seeding equipment and the pressure used in the process may injure the seed. Tests at the Intermountain Station have showed injury to 42 percent of the seed in pellets of this type.

SPECIES TESTED AND RESULTS

According to information available, the seeds of over 20 range plants and about 18 forest tree species have been tested in pelleted form (Table 1). The range species, chiefly grasses and legumes, include the following: purple alfalfa, smilograss, big bluegrass, canby bluegrass, mountain brome, smooth brome, soft brome, California bur-clover, tomcat clover, sweet clover, sand dropseed, Ehrharta calycina, foxtail (arundinaceous), Harding grass, Lehmann lovegrass, sand lovegrass, weeping lovegrass, Wilman lovegrass, California needlegrass, hyaline needlegrass, common ryegrass, Wimmera ryegrass, timothy, crested wheatgrass, and western wheatgrass. The tree species tested are Douglas-fir; balsam, noble, and Pacific silver firs; western hemlock; jack, loblolly, longleaf, ponderosa red, slash, eastern white, and western white pines; Port-Orford cedar; and black, Norway, Sitka, and white spruces.

Range seeding of pelleted seed has been quite extensive. Over 90,000 acres has been sown aerially on Indian reservations in Arizona alone, and the Southwestern Region of the Forest Service has contracted for similar sowing of 6,400 acres this spring (1949). Altogether, aerial seeding, broadcast

seeding, and drill seeding have been tried on several types of land and soil conditions. So far, results usually have been poor, and only fair at the best. Pelleted seeds have done no better than bare seeds, and in some cases have done worse. To be equal economically, grass seed would have to increase in cost at least three times (for some species), or the present cost of pelleting would have to drop to about 1/4 of what it is, was the conclusion reached from one set of studies.

The results with sowing pelleted tree seeds have been predominantly poor, occasionally fair, and rarely good. In one case only have pelleted seeds given results better than those with bare seeds. Usually they were about the same, but in several instances they were worse. Seeding has been done in many localities, on prepared and unprepared ground, broadcast (by hand or from airplanes) or in seedspots; in the laboratory, nursery, or field -- none of the methods tried can yet be called successful. The most extensive tests have been made in Ontario where several hundred acres have been sown with pelleted seed, both by airplane and ground methods.

A major stumbling block, both with range and forest species, has been the inability to find a uniformly successful rodent repellent which could be incorporated in the pellets. Several agencies are searching for such repellents and success may attend their efforts at any time.

RECOMMENDATIONS FOR FURTHER STUDIES

Since no highly promising leads have developed from research to date, the time does not seem ripe for large-scale studies with pelleted seed. However, further exploratory studies do seem desirable to test additional species, to sample more conditions, and to try new kinds of pellets or additional repellents and other additives as they become available. In all tests it would be desirable to protect part of the spots from birds and rodents and to sow bare seeds of the same lots as controls.

Table 1.- Results of pelleted seed tests. º

Species	Pelleting materials	Source of 1/ Pellets	Methods of sowing	Results	Compared with controls	Agency making test
			Range Plants			
Grasses and legumes 2/	Montmorillonite, and montmorillonite plus inert filler	1	Broadcast sown on various types of land	Poor to fair	No better	S.C.S.
Grasses and legumes 3/	Clay and fertilizers plus rodent repellent	2	Aerial seeding	Poor to fair	No better	U.S.I.S.
Grasses (mainly crested wheat grass)	Clay	2	In laboratory and field	Poor	Worse	Int.F. and R.E.S.
Lehmann, sand, and Wilman lovegrasses	Clay	2	In field	Poor	No better	S.W.F. and R.E.S.
Range plants	Clay	2	Broadcast and drilled in field	Poor	No better	Bur. Land Mgt.
			Forest Trees			
Douglas-fir	Montmorillonite; feldspar and fly ash	1, 3	In field plots	Poor	No better	P.N.W.F. & R.E.S.
	Raw clay plus repellents	4	Outdoor flats and field plots	Fair to good	No better	F.W.S.
Balsam fir	Feldspar and fly ash	3	In field plots	Poor	Worse	Cons. W. & P. Co.
Noble fir	Montmorillonite; feldspar and fly ash	1, 3	In field plots	Poor	No better	P.N.W.F. & R.E.S.
	Raw clay plus repellents	4	Outdoor flats and field plots	None	No better	F.W.S.
Pacific silver fir	Raw clay plus repellents	4	Outdoor flats and field plots	None	No better	F.W.S.
Western hemlock	Montmorillonite	1	Seed spots in field	Poor to fair	No better	Crown-Zellerbach
	Montmorillonite; feldspar and fly ash	1, 3	In field plots	Poor	No better	P.N.W.F. & R.E.S.
	Raw clay plus repellents	4	Outdoor flats and field plots	Poor to fair	Worse	F.W.S.

Species	Pelleting materials	Source of [1] Pellets	Methods of sowing	Results	Compared with controls	Agency making test
Jack pine	Clay and other materials[4]	4	In laboratory flats	Poor	Worse	F.W.S.
Loblolly pine	Clay and fertilizers, fungicide and repellent	4	In field and green house	Fair	No better	Champion Fiber
	Montmorillonite; feldspar and fly ash	1, 3	Sown in nursery	Poor	Worse	Miss. F.S.
Longleaf pine	Montmorillonite; feldspar and fly ash	1, 3	Sown in nursery	Poor	Worse	Miss. F.S.
	Clay and fertilizer; fungicide and repellent	4	In field and green house	Fair	No better	Champion Fiber
Ponderosa pine	Not reported	-	In field--screened and unprotected	Fair	No better	F.W.S.
Red pine	Feldspar and fly ash	3	Sown in nursery	Poor	Worse	M.S.C.
	Diatomaceous earth and fly ash	4	In field	Poor	Worse	Ont. Dept. of Forest & Lands
Slash pine	Feldspar and fly ash	3	In field on prepared or unprepared ground	Poor	Worse	Fla. F.S.
	Montmorillonite; feldspar and fly ash	1, 3	Sown in nursery	Poor	Worse	Miss. F.S.
Eastern white pine	Feldspar and fly ash	3	Sown in nursery	Poor	Worse	M.S.C.
	Diatomaceous earth and fly ash	4	In field	Poor	Worse	Ont. Dept. of Forest & Lands
Western white pine	Local clay	4	In field	Fair	No better	Kaniksu N.F.
Port-Orford cedar	Montmorillonite	1	Seed spots in field	Poor to fair	No better	Crown-Zellerbach
Black spruce	Feldspar and fly ash	3	In field plots	Good	Better	Cons. W. & P. Co.
Norway spruce	Feldspar and fly ash	3	Sown in nursery	Poor	Worse	M.S.C.
Sitka spruce	Montmorillonite	1	Seed spots in field	Poor to fair	No better	Crown-Zellerbach
	Montmorillonite; feldspar and fly ash	1, 3	In field	Poor	No better	P.N.W.F. & R.E.S.
White spruce	Feldspar and fly ash	3	Sown in nursery	Poor	Worse	M.S.C.

Species	Pelleting materials	Source of 1/ Pellets	Methods of sowing	Results	Compared with controls	Agency making tests
White spruce	Feldspar and fly ash	3	In field plots	Poor	Worse	Cons. W. & P. Co.
	Diatomaceous earth and fly ash	4	In field	Poor	Worse	Ont. Dept. of Lands & Forests

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[a] Please do not quote any results without clearance from agency making the tests.

1/ 1 = Filtrol Corporation, 2 = International Seed Pelleting Company, 3 = Processed Seeds, Inc., 4 = locally made.

2/ Included Alopecurus arundinaceus, Bromus mollis, B. carinatus, Ehrharta calycina, Eragrostis lehmanniana, Lolium multiflorum, L. subulatum, Medicago hispida, M. sativa, Oryzopsis miliacea, Phalaris tuberosa stenoptera, Poa ampla, P. canbyi, Stipa hyalina, S. pulchra, Trifolium tridentatum.

3/ Eragrostis lehmanniana, E. curvula, Sporobulus cryptandrus, Agropyron Smithii, A. cristatum, Bromus inermis, Melilotus sp., and Phleum pratense.

4/ Ground rattle bush bean, plaster of Paris, tung nut pomace, kaolin, dextrin, modelling clay, ball clay, powdered foamglass, dithiobiuret, anthraquinone, and compound No. 11-317 used in combinations.

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